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(54) **SYSTEMS AND METHODS FOR INSERTION AND REMOVAL OF INFORMATION HANDLING RESOURCE MODULE**

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(51) **Int. Cl.**

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| ***H05K 13/04*** | (2006.01) |
| ***H01R 43/22*** | (2006.01) |
| ***H01R 43/26*** | (2006.01) |

(52) **U.S. Cl.**

CPC ..... ***B25B 27/20*** (2013.01); ***H01R 43/22*** (2013.01); ***H01R 43/26*** (2013.01); ***H05K 13/0491*** (2013.01)

(58) **Field of Classification Search**

CPC ..... B25B 27/20; H01R 43/22; H01R 43/26; H05K 13/0491

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 4,392,301 | A * | 7/1983 | Hannes | H05K 13/0491 29/758 |
| 4,723,361 | A * | 2/1988 | Carlson | H05K 13/0491 29/758 |
| 4,756,078 | A * | 7/1988 | Dougherty | H05K 13/0491 29/268 |
| 4,979,287 | A * | 12/1990 | Schwab | H05K 13/0491 29/764 |
| 5,062,201 | A * | 11/1991 | Long, Jr. | H05K 13/0491 29/764 |
| 5,265,328 | A * | 11/1993 | Gorman | H05K 7/1415 29/829 |
| 5,365,653 | A * | 11/1994 | Padrun | H05K 13/0491 29/764 |
| 5,842,261 | A * | 12/1998 | Ortiz | H01R 43/205 29/260 |
| 2014/0170881 | A1 * | 6/2014 | DeCesaris | H05K 13/0491 439/327 |

* cited by examiner

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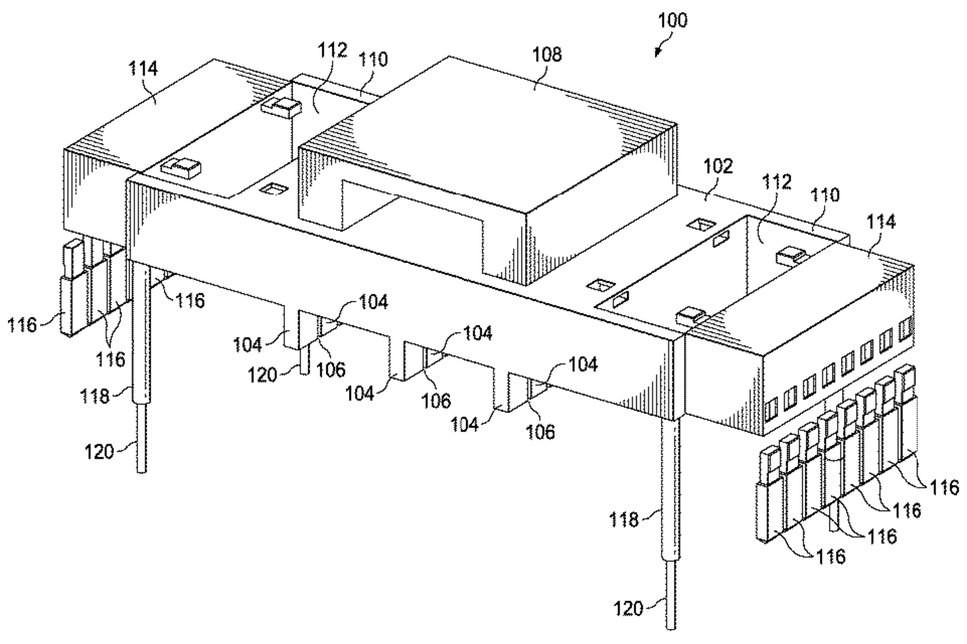
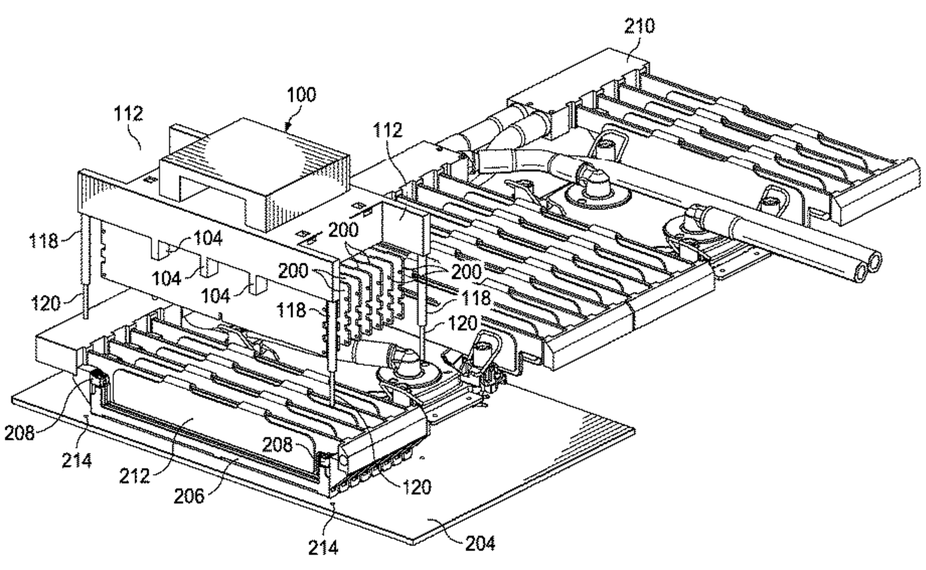
(57) **ABSTRACT**

In accordance with embodiments of the present disclosure, a tool may include a main body and a plurality of fingers extending from one side of the main body, the fingers arranged in a plurality of rows and a plurality of columns such that in each of the plurality of rows, each pair of adjacent fingers in a row may have a gap formed in between such pair of adjacent fingers such that each gap may receive a component for insertion or removal from a system and such that the adjacent fingers apply a force to the component to retain the component within the tool. The tool may also include a receptacle formed at one end of the main body and configured to receive a removable arm, and wherein the removable arm is configured to receive a plurality of removable fingers.

**12 Claims, 3 Drawing Sheets**



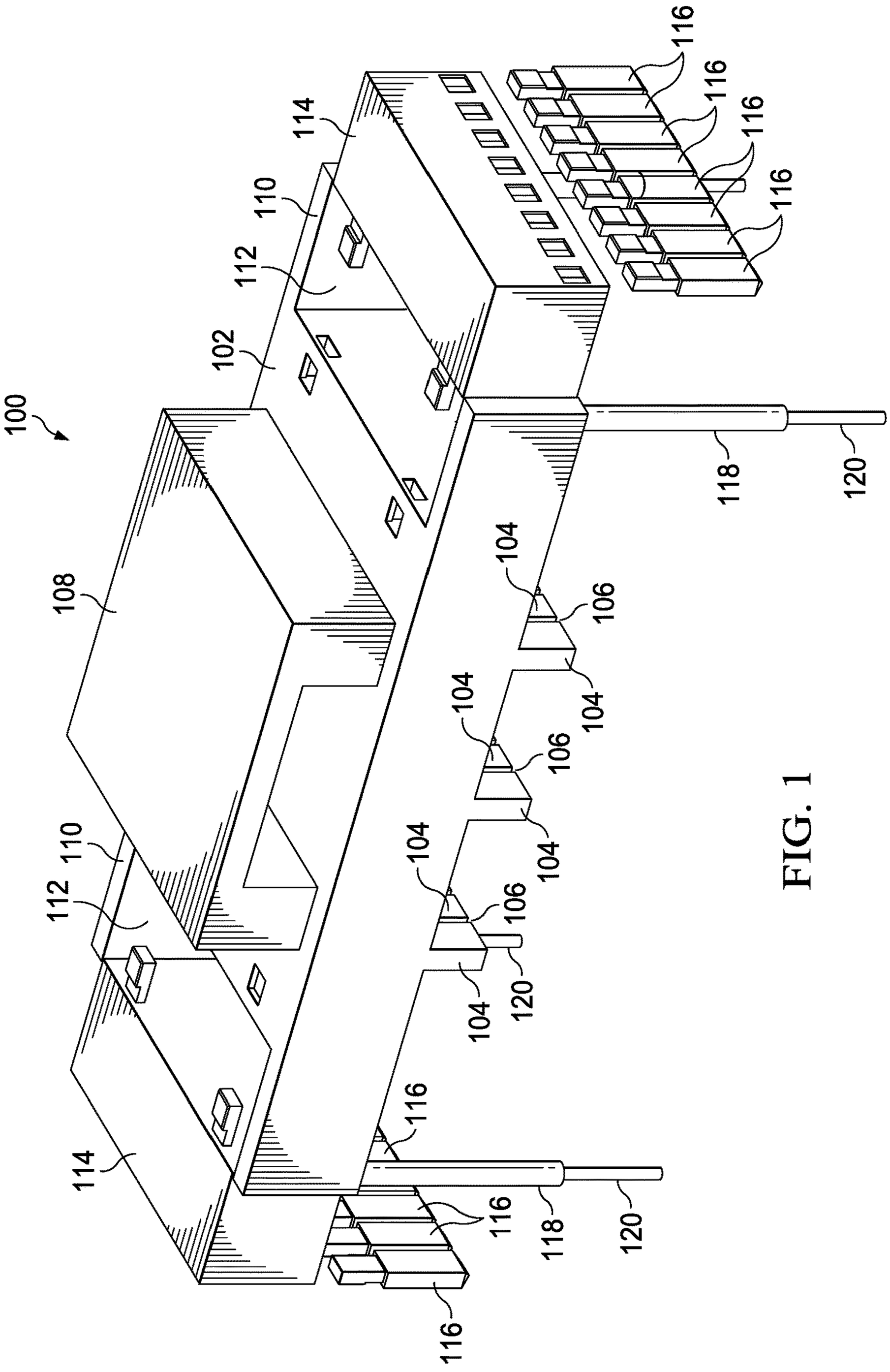



FIG. 1

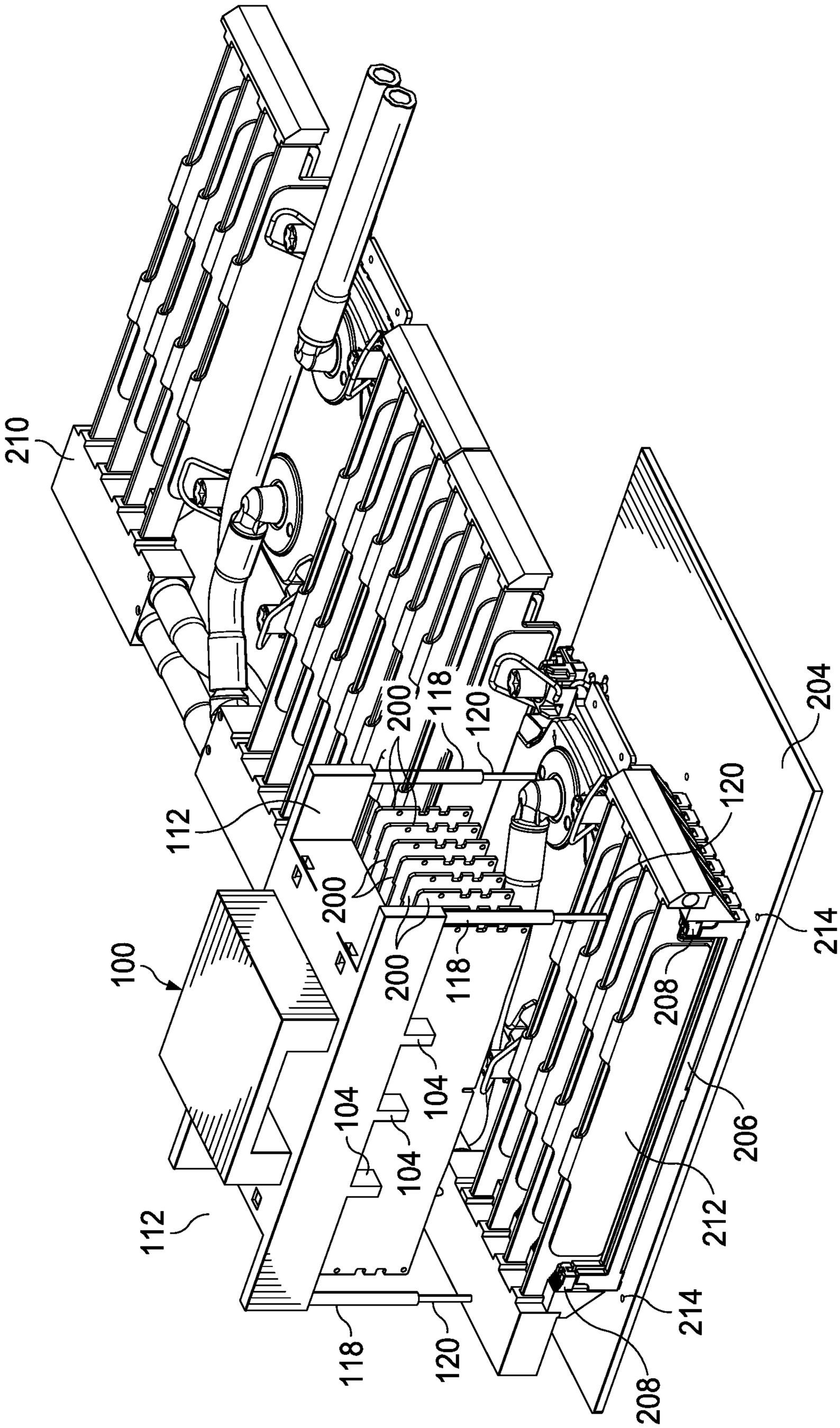

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FIG. 2

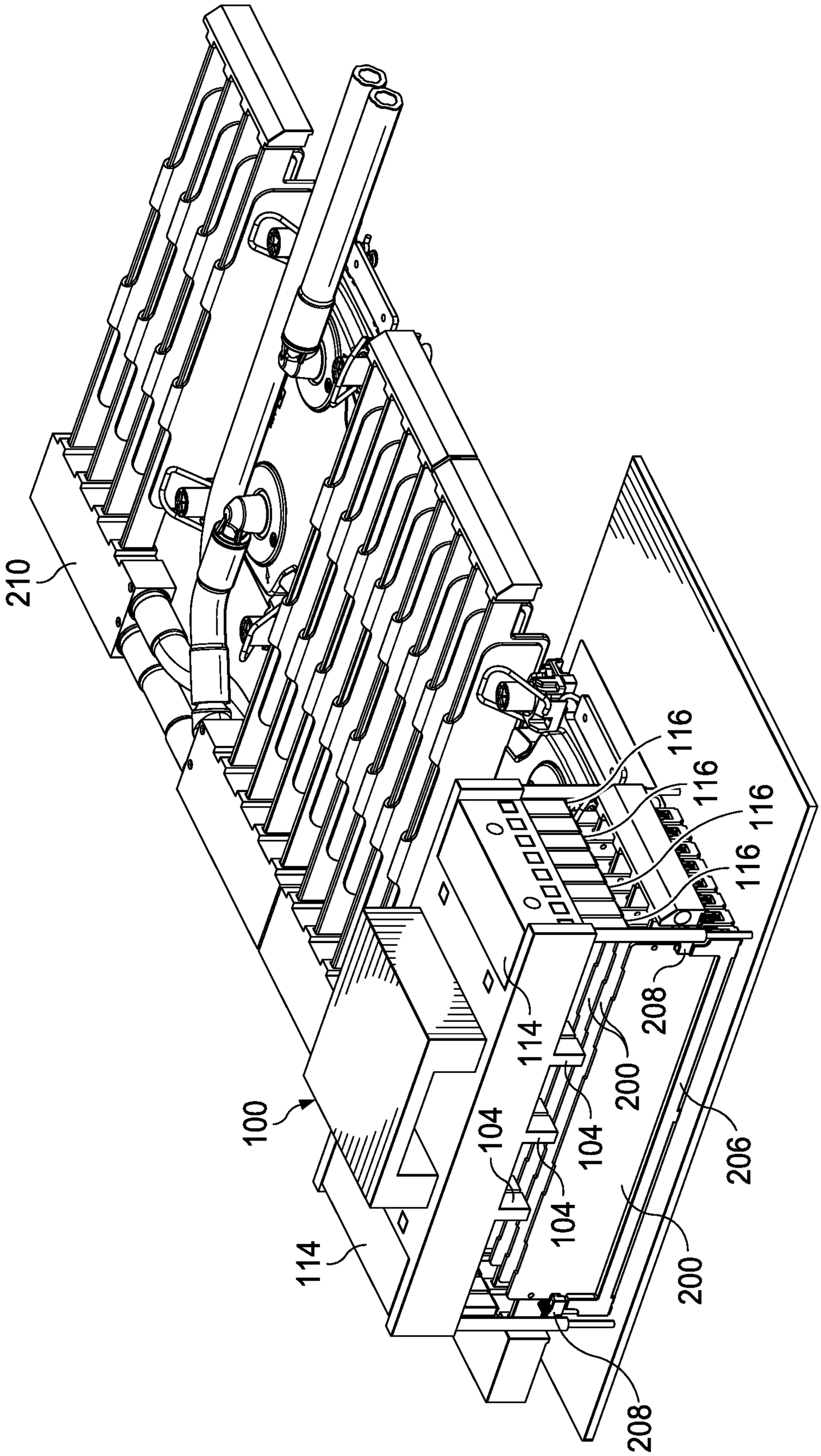


FIG. 3

# SYSTEMS AND METHODS FOR INSERTION AND REMOVAL OF INFORMATION HANDLING RESOURCE MODULE

## TECHNICAL FIELD

The present disclosure relates in general to information handling systems, and more particularly to insertion and removal of an information handling resource module in an information handling system.

## BACKGROUND

As the value and use of information continues to increase, individuals and businesses seek additional ways to process and store information. One option available to users is information handling systems. An information handling system generally processes, compiles, stores, and/or communicates information or data for business, personal, or other purposes thereby allowing users to take advantage of the value of the information. Because technology and information handling needs and requirements vary between different users or applications, information handling systems may also vary regarding what information is handled, how the information is handled, how much information is processed, stored, or communicated, and how quickly and efficiently the information may be processed, stored, or communicated. The variations in information handling systems allow for information handling systems to be general or configured for a specific user or specific use such as financial transaction processing, airline reservations, enterprise data storage, or global communications. In addition, information handling systems may include a variety of hardware and software components that may be configured to process, store, and communicate information and may include one or more computer systems, data storage systems, and networking systems.

As processors, graphics cards, random access memory (RAM) and other components in information handling systems have increased in clock speed and power consumption, the amount of heat produced by such components as a side-effect of normal operation has also increased. Often, the temperatures of these components need to be kept within a reasonable range to prevent overheating, instability, malfunction and damage leading to a shortened component lifespan. Accordingly, air movers (e.g., cooling fans and blowers) have often been used in information handling systems to cool information handling systems and their components.

To control temperature of components of an information handling system, an air mover may direct air over one or more heatsinks thermally coupled to individual components. Traditional approaches to cooling components may include a "passive" cooling system that serves to reject heat of a component to air driven by one or more system-level air movers (e.g., fans) for cooling multiple components of an information handling system in addition to the peripheral component. Another traditional approach may include an "active" cooling system that uses liquid cooling, in which a heat-exchanging cold plate is thermally coupled to the component, and a chilled fluid is passed through conduits internal to the cold plate to remove heat from the component.

One type of information handling resource in which active liquid cooling may be used is dual inline memory modules or DIMMs. DIMMs are widely used in information handling systems to store data. Generational improvements



have allowed DIMM pitch to decrease and DIMM count in information handling system servers to increase. Traditionally, DIMM insertion and removal has been performed one module at a time. As power consumption of information handling resources has increased, the need for liquid cooling has increased. While existing liquid cooling systems focus primarily on cooling of processors, future generations of information handling systems may benefit from active liquid cooling of DIMMs.

In order to cool a DIMM, a liquid cooling manifold may run directly on either side of the DIMM, in the channel between adjacent DIMMs. A space between the DIMM and the manifold may be filled with a thermal interface material. The thermal interface material may be somewhat delicate and may require careful installation in conjunction with a DIMM module itself, otherwise an unnecessarily high thermal contact resistance between the DIMM and the manifold may exist. Tight spaces among the thermal interface material, DIMM, and liquid manifold may render it difficult for a person to insert or remove DIMMs quickly in an information handling system, and may create service problems when a thermal interface material is improperly applied between two surfaces.

## SUMMARY

In accordance with the teachings of the present disclosure, the disadvantages and problems associated with insertion and removal of an information handling resource from an information handling system may be substantially reduced or eliminated.

In accordance with embodiments of the present disclosure, a tool may include a main body and a plurality of fingers extending from one side of the main body, the fingers arranged in a plurality of rows and a plurality of columns such that in each of the plurality of rows, each pair of adjacent fingers in a row may have a gap formed in between such pair of adjacent fingers such that each gap may receive a component for insertion or removal from a system and such that the adjacent fingers apply a force to the component to retain the component within the tool. The tool may also include a receptacle formed at one end of the main body and configured to receive a removable arm, and wherein the removable arm is configured to receive a plurality of removable fingers. Features of the tool may be arranged such that in order to insert one or more components into the system, the receptacle remains unpopulated by the removable arm, the tool is inserted towards one or more respective connectors of the system for the one or more components, and a retention force applied by respective connectors to the one or more components maintains the one or more components in place when the tool is removed away from the respective connectors, and in order to remove one or more components from the system, the receptacle is populated with the removable arm, the removable arm is, for each component desired to be removed, populated with a respective removable finger, the tool is inserted towards one or more respective connectors of the system for the one or more components and a release force applied by the removable fingers releases the retention force, such that the force applied by the fingers is sufficient to remove the components from their respective connectors when the tool is removed away from the respective connectors.

In accordance with these and other embodiments of the present disclosure, a method may include forming a tool with a main body and a plurality of fingers extending from one side of the main body, the fingers arranged in a plurality

of rows and a plurality of columns such that in each of the plurality of rows, each pair of adjacent fingers in a row may have a gap formed in between such pair of adjacent fingers such that each gap may receive a component for insertion or removal from a system and such that the adjacent fingers apply a force to the component to retain the component within the tool. The method may also include forming a receptacle at one end of the main body configured to receive a removable arm, wherein the removable arm is configured to receive a plurality of removable fingers. The tools may be formed such that in order to insert one or more components into the system, the receptacle remains unpopulated by the removable arm, the tool is inserted towards one or more respective connectors of the system for the one or more components, and a retention force applied by respective connectors to the one or more components maintains the one or more components in place when the tool is removed away from the respective connectors, and in order to remove one or more components from the system, the receptacle is populated with the removable arm, the removable arm is, for each component desired to be removed, populated with a respective removable finger, the tool is inserted towards one or more respective connectors of the system for the one or more components and a release force applied by the removable fingers releases the retention force, such that the force applied by the fingers is sufficient to remove the components from their respective connectors when the tool is removed away from the respective connectors.

Technical advantages of the present disclosure may be readily apparent to one skilled in the art from the figures, description and claims included herein. The objects and advantages of the embodiments will be realized and achieved at least by the elements, features, and combinations particularly pointed out in the claims.

It is to be understood that both the foregoing general description and the following detailed description are examples and explanatory and are not restrictive of the claims set forth in this disclosure.

## BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the present embodiments and advantages thereof may be acquired by referring to the following description taken in conjunction with the accompanying drawings, in which like reference numbers indicate like features, and wherein:

FIG. **1** illustrates an isometric view of an example tool for insertion and removal of DIMMs in an information handling system, in accordance with embodiments of the present disclosure;

FIG. **2** illustrates an isometric view of the tool shown in FIG. **1** and selected components of an information handling system and demonstrates insertion of DIMMs into an information handling system, in accordance with embodiments of the present disclosure; and

FIG. **3** illustrates an isometric view of the tool shown in FIG. **1** and selected components of an information handling system and demonstrates removal of DIMMs from an information handling system, in accordance with embodiments of the present disclosure.

## DETAILED DESCRIPTION

Preferred embodiments and their advantages are best understood by reference to FIGS. **1** through **3**, wherein like numbers are used to indicate like and corresponding parts.

For the purposes of this disclosure, an information handling system may include any instrumentality or aggregate of instrumentalities operable to compute, classify, process, transmit, receive, retrieve, originate, switch, store, display, manifest, detect, record, reproduce, handle, or utilize any form of information, intelligence, or data for business, scientific, control, entertainment, or other purposes. For example, an information handling system may be a personal computer, a PDA, a consumer electronic device, a network storage device, or any other suitable device and may vary in size, shape, performance, functionality, and price. The information handling system may include memory, one or more processing resources such as a central processing unit (CPU) or hardware or software control logic. Additional components of the information handling system may include one or more storage devices, one or more communications ports for communicating with external devices as well as various input and output (I/O) devices, such as a keyboard, a mouse, and a video display. The information handling system may also include one or more buses operable to transmit communication between the various hardware components.

For the purposes of this disclosure, computer-readable media may include any instrumentality or aggregation of instrumentalities that may retain data and/or instructions for a period of time. Computer-readable media may include, without limitation, storage media such as a direct access storage device (e.g., a hard disk drive or floppy disk), a sequential access storage device (e.g., a tape disk drive), compact disk, CD-ROM, DVD, random access memory (RAM), read-only memory (ROM), electrically erasable programmable read-only memory (EEPROM), and/or flash memory; as well as communications media such as wires, optical fibers, microwaves, radio waves, and other electromagnetic and/or optical carriers; and/or any combination of the foregoing.

For the purposes of this disclosure, information handling resources may broadly refer to any component system, device or apparatus of an information handling system, including without limitation processors, buses, memories, I/O devices and/or interfaces, storage resources, network interfaces, motherboards, integrated circuit packages; electro-mechanical devices (e.g., air movers), displays, and power supplies.

FIG. **1** illustrates an isometric view of an example tool **100** for insertion and removal of DIMMs in an information handling system, in accordance with embodiments of the present disclosure. As shown in FIG. **1**, tool **100** may include main body **102**, a plurality of spaced fingers **104** extending from a bottom of main body **102**, a handle **108** extending from a top of main body **102** opposite of the bottom of main body **102**, a pair of opposite ends **110** each having a receptacle **112** formed therein, a pair of removable arms **114** each configured to be selectively inserted and removed from a corresponding receptacle **112**, a plurality of removable fingers **116** each configured to be selectively inserted and removed from a corresponding removable arm **114**, a plurality of guide legs **118** extending from the corners of edges of the bottom of main body **102**, and a plurality of guide pins **120** with each guide pin **120** extending from a respective guide leg **118**.

As shown, fingers **104** may be arranged closely in rows along the bottom of tool **100** with small gaps **106** between pairs of fingers **104** in each row. Fingers **104** may also be arranged in columns along the bottom of tool **100**, but with more spacing between fingers **104** in a column than with fingers **104** in a row. Fingers **104** may be arranged along the bottom of tool **104** such that a DIMM or other information

handling resource may be grasped within a plurality of gaps **106** and held in place by compressive force between adjacent pairs of fingers **104** on either side of each gap **106**.

Handle **108** may comprise any suitable mechanical feature adapted for use by a person to grasp handle **108** in order to insert and remove information handling resources, as described in greater detail below.

Receptacles **112** may be formed at each end **110** of main body **102**, and each receptacle **112** may be configured to receive a respective removable arm **114**. As described in greater detail below, removable arms **114** may be inserted into receptacles **112** in order to remove information handling resources from an information handling system. In addition, as described below, removable fingers **116** may also be inserted into removable arms **114** in order to remove information handling resources from an information handling system. However, if desired to remove only some but not all of a plurality of information handling resources from an information handling system, a user may leave receptacles of a removable arm **114** corresponding to information handling resources undesired for removal unpopulated without a removable finger **116** inserted therein. In operation during a removal, a removable finger **116** may be configured to interact with a latching mechanism of an information handling resource and/or a connector for receiving the information handling resource, in order to unlatch the latching mechanism to permit removal of such information handling resource.

When inserting information handling resources into an information handling system, removable arms **114** may be removed from main body **102**.

FIG. **2** illustrates an isometric view of tool **100** and selected components of an information handling system and demonstrates insertion of DIMMs **200** into the information handling system, in accordance with embodiments of the present disclosure. As shown in FIG. **2**, an information handling system may include a circuit board **204** (e.g., motherboard or backplane) having a plurality of receptacle connectors **206** each configured to receive a respective DIMM **200**. As shown in FIG. **2**, each receptacle connector **206** may include one or more latching mechanisms **208** to mechanically retain an installed DIMM **200** in place within such receptacle connector **206**. Also as shown in FIG. **2**, the information handling system may also include a liquid cooling system **210** that includes a manifold **212** arranged relative to receptacle connectors **206** in order to provide liquid cooling to DIMMs **200** installed in receptacle connectors **206**.

As shown in FIG. **2**, in order to insert DIMMs **200** into the information handling system, a user may insert each DIMM **200** desired to be installed into a plurality of gaps **106** such that each DIMM **200** is held in place within tool **100** by pairs of adjacent fingers **104**. To engage each DIMM **200** with its respective receptacle connector **206**, the user may lower the tool **100** towards circuit board **204**, aligning guide pins **120** with corresponding guide holes **214** formed on or within circuit board **204**. Once DIMMs **200** are lowered sufficiently to engage with their respective receptacle connectors **206**, latching mechanisms **208** may engage DIMMs **200** and may retain DIMMs **200** within receptacle connectors **206** with sufficient force to overcome the force by which DIMMs **200** are held within gaps **106**, such that after insertion of DIMMs **200** into receptacle connectors **206**, the user may lift tool **100** away from circuit board **206** and DIMMs **200** may remain inserted into receptacle connectors **206**.

FIG. **3** illustrates an isometric view of the tool **100** and selected components of the information handling system depicted in FIG. **2** and demonstrates removal of DIMMs **200** from the information handling system, in accordance with embodiments of the present disclosure. As shown in FIG. **3**, to remove DIMMs **200** from the information handling system, the user may populate receptacles **112** of tool **100** with removable arms **114** and, for each DIMM **200** desired to remove, install a pair of opposing removable fingers **116** within removable arms **114** corresponding to the position of such desired DIMM **200**. The user may lower the tool **100** towards circuit board **204**, aligning guide pins **120** with corresponding guide holes **214** formed on or within circuit board **204**. Once tool **100** is lowered sufficiently, removable fingers **116** may interact with latching mechanisms **208** to unlatch the desired DIMM(s) **200** from their respective receptacle connectors **206** and a plurality of gaps **106** may align with each desired DIMM **200** such that pairs of adjacent fingers **104** grasp each desired DIMM **200**. The user may then lift tool **100** away from circuit board **206** and desired DIMMs **200** may remain retained in tool **100** while DIMMs **200** not desired for removal remain inserted in their respective receptacle connectors **206**.

Although the foregoing describes insertion and removal of DIMMs **200** in an information handling system, it is understood that the methods and systems described herein may be applied for insertion and removal of any suitable information handling resources in an information handling system, and may be applied for insertion and removal of any component (whether or not electronic) from any suitable mechanical structure (whether or not electronic).

As used herein, when two or more elements are referred to as "coupled" to one another, such term indicates that such two or more elements are in electronic communication or mechanical communication, as applicable, whether connected indirectly or directly, with or without intervening elements.

This disclosure encompasses all changes, substitutions, variations, alterations, and modifications to the example embodiments herein that a person having ordinary skill in the art would comprehend. Similarly, where appropriate, the appended claims encompass all changes, substitutions, variations, alterations, and modifications to the example embodiments herein that a person having ordinary skill in the art would comprehend. Moreover, reference in the appended claims to an apparatus or system or a component of an apparatus or system being adapted to, arranged to, capable of, configured to, enabled to, operable to, or operative to perform a particular function encompasses that apparatus, system, or component, whether or not it or that particular function is activated, turned on, or unlocked, as long as that apparatus, system, or component is so adapted, arranged, capable, configured, enabled, operable, or operative. Accordingly, modifications, additions, or omissions may be made to the systems, apparatuses, and methods described herein without departing from the scope of the disclosure. For example, the components of the systems and apparatuses may be integrated or separated. Moreover, the operations of the systems and apparatuses disclosed herein may be performed by more, fewer, or other components and the methods described may include more, fewer, or other steps. Additionally, steps may be performed in any suitable order. As used in this document, "each" refers to each member of a set or each member of a subset of a set.

Although exemplary embodiments are illustrated in the figures and described above, the principles of the present disclosure may be implemented using any number of techniques, whether currently known or not. The present disclo-

sure should in no way be limited to the exemplary implementations and techniques illustrated in the figures and described above.

Unless otherwise specifically noted, articles depicted in the figures are not necessarily drawn to scale.

All examples and conditional language recited herein are intended for pedagogical objects to aid the reader in understanding the disclosure and the concepts contributed by the inventor to furthering the art, and are construed as being without limitation to such specifically recited examples and conditions. Although embodiments of the present disclosure have been described in detail, it should be understood that various changes, substitutions, and alterations could be made hereto without departing from the spirit and scope of the disclosure.

Although specific advantages have been enumerated above, various embodiments may include some, none, or all of the enumerated advantages. Additionally, other technical advantages may become readily apparent to one of ordinary skill in the art after review of the foregoing figures and description.

To aid the Patent Office and any readers of any patent issued on this application in interpreting the claims appended hereto, applicants wish to note that they do not intend any of the appended claims or claim elements to invoke 35 U.S.C. § 112(f) unless the words "means for" or "step for" are explicitly used in the particular claim.

What is claimed is:

**1**. A tool, comprising:

a main body;

a plurality of fingers extending from one side of the main body, the fingers arranged in a plurality of rows and a plurality of columns such that in each of the plurality of rows, each pair of adjacent fingers in a row has a gap formed in between the pair of adjacent fingers such that each gap receives a component for insertion or removal from a system and such that the adjacent fingers apply a force to the component to retain the component within the tool; and

a receptacle formed at one end of the main body and configured to receive a removable arm, and wherein the removable arm is configured to receive a plurality of removable fingers;

such that:

in order to insert one or more components into the system, the receptacle remains unpopulated by the removable arm, the tool is inserted towards one or more respective connectors of the system for the one or more components, and a retention force applied by latches of respective connectors to the one or more components maintains the one or more components in place when the tool is removed from the respective connectors; and

in order to remove one or more components from the system, the receptacle is populated with the removable arm, the removable arm is, for each component desired to be removed, populated with a respective removable finger, the tool is inserted towards one or more respective connectors of the system for the one or more components and a release force applied by the removable fingers releases the retention force, such that the force applied by the fingers is sufficient to remove the components from their respective connectors when the tool is removed from the respective connectors.

**2**. The tool of claim **1**, wherein the tool further comprises guiding features configured to align with corresponding alignment features of the system, in order to align the tool with the connectors.

**3**. The tool of claim **2**, wherein the alignment features comprise holes and the guiding features comprise guide pins.

**4**. The tool of claim **1**, wherein the component comprises an information handling resource and the system comprises an information handling system.

**5**. The tool of claim **1**, wherein the component comprises a dual inline memory module and the system comprises an information handling system.

**6**. The tool of claim **1**, wherein the release force is applied by the removable fingers to the latch of the connector.

**7**. A method, comprising:

forming a tool with a main body and a plurality of fingers extending from one side of the main body, the fingers arranged in a plurality of rows and a plurality of columns such that in each of the plurality of rows, each pair of adjacent fingers in a row has a gap formed in between the pair of adjacent fingers such that each gap receives a component for insertion or removal from a system and such that the adjacent fingers apply a force to the component to retain the component within the tool; and

forming a receptacle at one end of the main body configured to receive a removable arm, wherein the removable arm is configured to receive a plurality of removable fingers;

such that:

in order to insert one or more components into the system, the receptacle remains unpopulated by the removable arm, the tool is inserted towards one or more respective connectors of the system for the one or more components, and a retention force applied by latches of respective connectors to the one or more components maintains the one or more components in place when the tool is removed from the respective connectors; and

in order to remove one or more components from the system, the receptacle is populated with the removable arm, the removable arm is, for each component desired to be removed, populated with a respective removable finger, the tool is inserted towards one or more respective connectors of the system for the one or more components and a release force applied by the removable fingers releases the retention force, such that the force applied by the fingers is sufficient to remove the components from their respective connectors when the tool is removed from the respective connectors.

**8**. The method of claim **7**, further comprising forming guiding features on the tool configured to align with corresponding alignment features of the system, in order to align the tool with the connectors.

**9**. The method of claim **8**, wherein the alignment features comprise holes and the guiding features comprise guide pins.

**10**. The method of claim **7**, wherein the component comprises an information handling resource and the system comprises an information handling system.

**11**. The method of claim **7**, wherein the component comprises a dual inline memory module and the system comprises an information handling system.

12. The method of claim 7, wherein the release force is applied by the removable fingers to the latch of the connector.

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